FROST AND FRUIT IN SOUTHERN OHIO IN 1917.

WILLIAM H. ALEXANDER, Meteorologist.

[U. S. Weather Bureau, Columbus, Ohio, December, 1917.]

As is well known, most fruit crops in Ohio, especially southern Ohio, were very poor in 1917, and, of course, the botanist, the orchardist, the meteorologist, and in fact the public generally would like to know, if possible, the reason or reasons for this. Naturally, all turn to the weather for the most probable explanation. Under date of May 18, 1917, Prof. Selby (1) called the attention of this office to certain observed facts and conditions that seem to be of more than passing interest in regard to the effects of the weather during the preceding winter on apple, peach, plum, and cherry trees and buds. His letter follows:

The writer has been much impressed by the unusual severity of the past winter's freezing injury to peach trees in southeastern Ohio, and likewise by the unusual damage in the destruction of fruit buds on sour cherry and European plum in the same district.

The curious feature of this injury which appealed to me in going over Lawrence, Gallia, Meigs, Athens, Washington, and Morgan Counties during the period from May 3 to 9, is the greater severity of the injury on the higher altitudes. This indicates injury during a period of high winds and low temperatures combined. These lowest temperatures through the district, as shown in the February number of "Climatological Data" (pp. 12, 16), indicates the second cold period of February, namely, February 11–13, as the most probable period in which this injury was caused.

I have recently been advised by correspondence of the killing back of 4-year-old peach trees near Pennsville, Morgan County, and of injury to apple and prunus fruits in Belmont County. Has your department any data for the more specific mapping of the minimum temperatures and wind velocities for these February storms in 1917?

I have noted that sour cherry in the lower altitudes has come through with comparative success, and blooming freely. Likewise in this district, although more generally the fruit buds of peach are killed here and in the southeastern district.

Indeed, I was not prepared personally for the general freezing injury to sour cherry blossoms in southeastern Ohio until the recent May visit. When examined in some detail on March 26–27 there did not seem to be a very serious injury to the blossom buds of sour cherry upon my Selby Heights Farm orchard, Sharpsburg, Athens County (altitude 950 to 1,000 feet), but the actual blooming and present promise is very, very light indeed, and restricted to a relatively small number of trees.

Owing to the well-authenticated Easter freeze injury of burst or opening buds on varieties of apple over this same territory, it is not quite clear in my mind that all our Athens County injury dates back to February. Some of it on the cherry may be referable to the Easter freezing. Upon this point, however, I gather from Prof. V. H. Davis (2) of the Ohio State University that in his judgment it was the February or pre-February freezing that injured the blossom buds of sour cherry on their Poplar Ridge Fruit Farm in Ross County.

Any additional mappings of the second February freeze, or of the April centers of minimum temperatures will be appreciated.

To the above statement of facts should be added one or two details subsequently observed by Prof. Selby, also by Prof. Davis (2) and others, namely, that "the tips of peach twigs have all buds killed upon them in rather low ground near Harrison, Hamilton County, and at Mount Healthy, Hamilton County, on elevated ground," and that "the bare twigs, still green as to bark and appearance, projected above the starting shoots lower down."

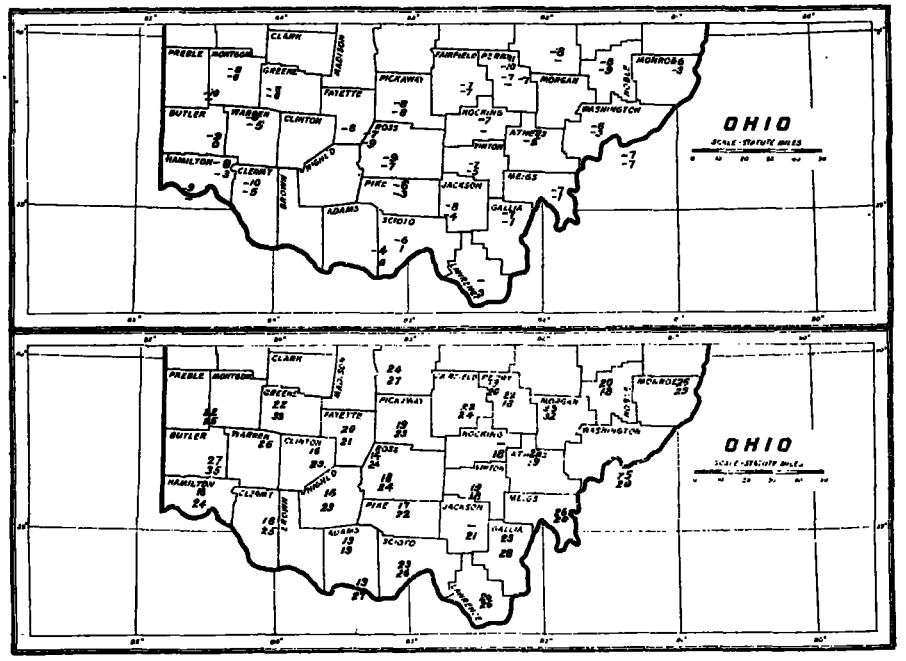

FIG. 1.—Minimum tepmperatures Feb. 5 (upper) and 12 (lower), 1917.
FIG. 2.—Minimum temperatures Apr. 9 (upper) and 14 (lower), 1917.

All are agreed, of course, that there was very serious injury to fruit tree and bud resulting in the almost total loss of some fruit crops and the partial loss of others, but there is considerable difference of opinion as to just when the injury occurred. In looking back over the weather record of the preceding winter and early spring, one finds four or five periods of weather conditions sufficiently abnormal and severe to make it probable that the damage was done during any one of them, namely, February 5, February 11–13, April 9–10, and April 13–15, and early May. For the benefit of those interested in the study of the points raised by Prof. Selby, figures 1 and 2 show the extreme temperatures that prevailed at the various stations in southern Ohio during the cold spells mentioned in February and April; also graphs (fig. 3) showing the hourly temperatures and wind velocities for these same periods at the regular

Weather Bureau stations at Cincinnati, Columbus, Dayton, and Pittsburgh. Figure 1 shows the minimum temperatures on February 5 and 12, the upper number in each entry being the minimum for the 5th and the lower that of the 12th. Similarly, figure 2 shows the minima for the 9th and 14th of April.

In arriving at an adequate explanation of the unexpected extent and severity of the injury to the fruit buds noted above, one should not, of course, overlook the antecedent weather conditions, particularly as to moisture, that prevailed during the early stages of the buds. The records show, for example, that the preceding July was very dry, there being only about one-half the usual amount of rain and that of a rather local character, some sections, as in Adams, Athens, Fayette, Montgomery, Noble, and Perry Counties, receiving far less than 50 per cent of the normal amount. In fact, from June 22 to August 3, 1916, more especially from June 22 to July 15—a very important, not to say critical, period in the life history of the fruit bud—the rainfall was very light and local, resulting in some really severe droughty conditions that may possibly, in spite of good autumnal rains, account for the fact that the fruit trees entered the winter season in a reduced state of vitality and the further fact that the "fruit buds appeared to be flabby," the peach buds lacking "plumpness," as pointed out by Professor Green (3) and Mr. Speaker (4). Possibly the character of the soil on the uplands, or "higher altitudes" referred to by Prof. Selby, was such that the droughty conditions affected more seriously the growth and vitality of the trees on the uplands than on the lowlands and therefore the adverse weather conditions of the winter and early spring would naturally affect first and more seriously the weakest, tenderest parts of the tree, namely, the buds and the "tips of the twigs." However, the facts are, in so far as can now be gathered from the available records, that in the main the maturity and ripening of the fruit buds in the fall and early winter of 1916 were about normal, nor is there anything in the records to indicate a late-growth development of an abnormal type.

As an indication of the stage of development of the buds in the spring of 1917, we must of necessity rely upon the record at the Ohio Agricultural Experiment Station at Wooster, which is in the northern part of the State, but no doubt is typical. The figures are furnished by Mr. C. W. Ellenwood, assistant horticulturist at that station, and are for three standard varieties, namely, Ben Davis, Grimes Golden, and Rome Beauty.

Ben Davis: First blossoms, May 17; full bloom, May 22, 1917.

Grimes Golden: First blossoms, May 14; full bloom, May 21, 1917.

Rome Beauty: First blossoms, May 16; full bloom, May 24, 1917.

This, we are informed, is the latest development of fruit buds on the apple on record at the experiment station, even later by a few days than that of 1920. Assuming, then, that the development was correspondingly late in southern portions of the State, it seems highly improbable that there was a sufficient advance or swelling of the buds in 1917 to make them easily susceptible to injury from the cold weather in April, nearly a month before the blooming stage was reached.

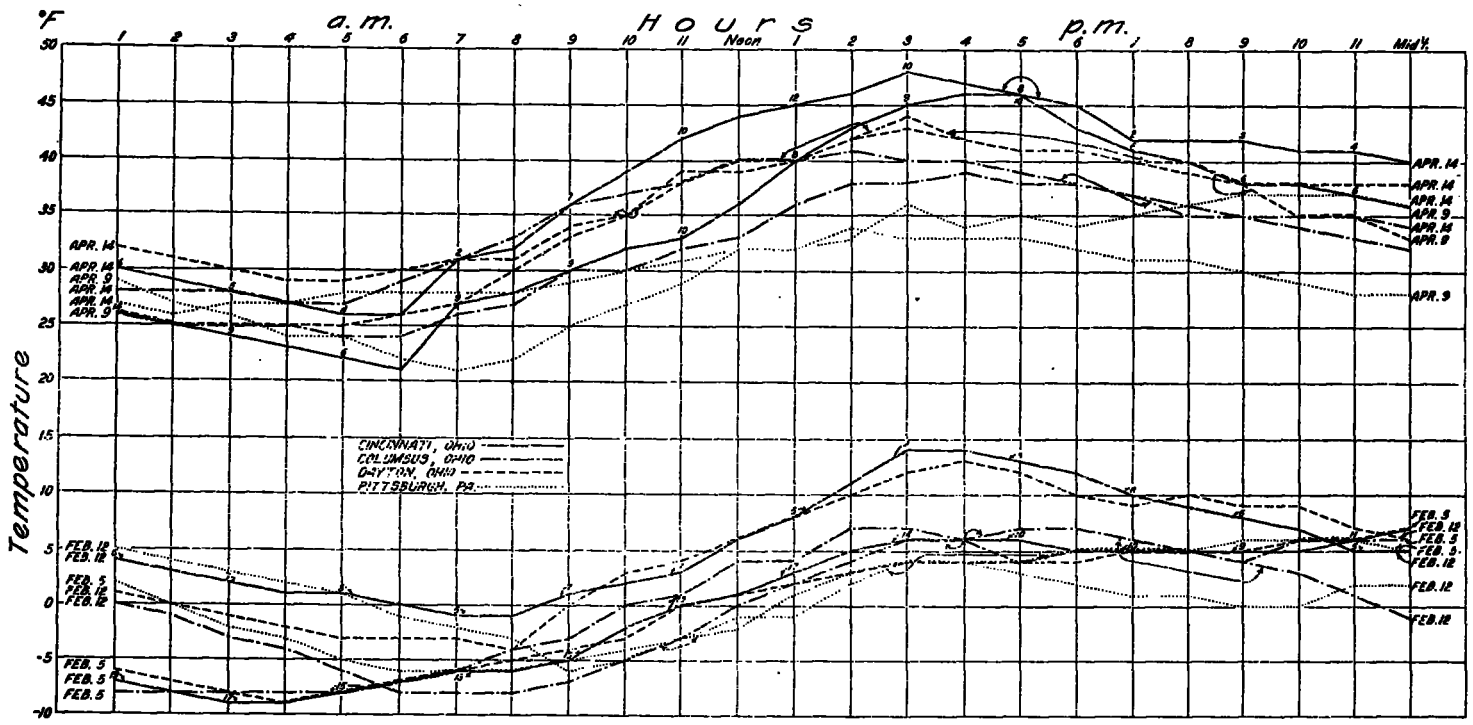

FIG. 3.—Hourly temperatures and bihourly wind velocities at Cincinnati and hourly temperature at Dayton, Columbus, and Pittsburgh, Feb. 5 and 12, and Apr. 9 and 14, 1917.

Looking further into the weather conditions of the spring of 1917, we find that May was an unprecedentedly cool month, as indicated from the following extract taken from the introduction to the section report for that month:

This was the coldest May in Ohio since the establishment of the Weather Bureau in 1871 and as cold as any other May in this State in more than 60 years. The average temperature for the State as a whole was 54.1°. This is just 7° below the normal and 13.8° below the high record of 1896. In 1867 the temperature for May was just the same as this month, while in 1897 it was 56.3° and in 1907, 54.5°. The weather was cold continuously during the first two weeks and again from the 22d to the 30th, the daily temperatures averaging from 10° to 20° below the normal during much of the time. Frost occurred in the northern and middle counties on the 3d, 8th, 9th, 10th and 14th; in the southern counties on the 10th and 14th, and in scattered localities on the 1st, 2d, 11th, 12th, 24th and 26th. On the 3d, 10th, and 14th the frost was quite severe, and freezing temperatures or lower were recorded on the 10th in the extreme southern counties. Considerable damage was done to early truck crops and other tender plants by these frosts, especially in the middle and southern portions of the State.

These unusually severe conditions for May occurred at about the critical period in the development of the fruit buds.

From the foregoing we are inclined to the opinion that the fatal injury to the fruit crop of 1917 in this State occurred either as the result of low temperatures on February 5, 1917, or the cool, wet weather during the period of pollinization in May. Although the temperatures experienced in February (5th and 11th) were not low enough to kill fully dormant peach or apple buds, the effect of the high winds and the unfavorable summer and autumn weather probably more than made up for any lack of sufficient coldness. The damage made by low temperatures appears to be largely owing to evaporation of moisture which can not be replaced while the buds are so cold. We are disposed, however, to attribute a large part, perhaps a major part, of the damage to May weather conditions at the critical period of pollinization.

REFERENCES.

(1) Augustine D. Selby, chief, Department of Botany, Ohio Agricultural Experiment Station, Wooster, Ohio.
(2) Vernon H. Davis, assistant professor of horticulture, Ohio State University, Columbus, Ohio.
(3) W. J. Green, vice director and chief, Department of Horticulture, Ohio Agricultural Experiment Station, Wooster, Ohio.
(4) H. J. Speaker, chief, deputy inspector, Bureau of Horticulture for Ohio, Columbus, Ohio.

COLD AIR PREVENTS SEVERE FREEZE.

By ANDREW M. HAMRICK, Meteorologist.

[Weather Bureau, Grand Junction, Colo., May 5, 1921.]

On the night of April 25–26 the Grand Valley of Colorado experienced a meteorological condition which, though in the nature of a paradox, may well be described under the caption, "Cold air prevents severe freeze."

A cyclone of marked intensity passed over that region on the 23d–24th. The station barometer reading, 24.69 inches, at 8 p. m. of the 23d was the lowest of record at Grand Junction in the last 12 months. Precipitation in the forms of rain and snow amounted to 0.29 inch in the city, which is more than one-third of the normal amount for the entire month. In the outlying fruit districts it was heavier, especially in the vicinity of Palisade, where several inches of moist snow covered the ground and a considerable amount hung on the fruit trees on the morning of the 24th.

During the cold season precipitation seldom occurs in the Grand Valley while the barometer is falling, but just after the turn upward, if the mercury has fallen to 25 inches or lower, precipitation is likely to begin and continue intermittently until it again approaches 25.50 inches. Although not a fixed rule, the precipitation is not continuous for many hours at a time, and the showers or flurries can be associated usually with small but sharp rises in the barometer.

Such conditions prevailed in the Grand Valley from 9:30 p. m. of the 23d until about noon of the 25th. At the latter hour the pressure was 25.33 inches. As the barometer was rising steadily, and local signs and the weather map indicated clearing, with the usual low temperatures caused by radiation on clear nights following storms of that character, grave apprehension concerning the fruit crop in the valley prevailed.

Clearing took place as indicated shortly after sunset, and the sky remained practically clear until about 4 a. m. of the 26th. Radiation was rapid, and the temperature fell from 47° at 6 p. m. of the 25th to 31° at about 4:30 a. m. of the 26th.

The wind was blowing steadily from the east from 1 a. m. until 3:30 a. m., when it switched abruptly to the northwest. In the springtime northwesterly winds carry colder air into the Grand Valley than do winds from any other direction. With the change in wind direction the temperature fall increased rapidly, and it soon passed below freezing.

Since there was a large amount of moisture in the valley, the relative humidity was probably quite high, and the rapidly falling temperature reached the dew point in a short while. Condensation took place in the form of a low stratus cloud, closely resembling a fog, and the latter moved rapidly across the valley from the NW. between the hours of 4 and 4:30 a. m. The cloud checked radiation, and in the process of condensation a considerable amount of latent heat must have been liberated close to the ground further to aid nature in her protective work.

Apples, peaches, and pears were in such an advanced stage of development that it is quite probable the loss would have been heavy had the temperature remained for an hour or more at the low degree reached in some districts before the cloud appeared. In fact, the hygrometric formulæ indicated minima 4° lower, on the average, than those which obtained, and meteorological conditions were ideal for the application of the formulæ, namely, a clear sky with rapid radiation, after the passing of a LOW.

Minimum temperatures at the various substations in the Grand Valley, together with those indicated by the combined hygrometric and maximum-minimum formulæ [1] were as follows:

Stations.	Minimum, 26th.	Indicated.	Difference.
	°	°	°
Clifton	29	27	+2
Fruita	28	23	+5
Fruitvale	29	24	+5
Hunter	28	24	+4
Loma	27	23	+4
Orchard Mesa	29	24	+5
Palisade	30	29	+1
Pomona	28	23	+5
Redlands	30	27	+3
Grand Junction	31	28	+3

On the following night, with practically the same weather indications, the formulæ indicated minima as follows; no cloud overspread the valley during the morning hours, and minimum temperatures were very close to the predicted:

Stations.	Minimum, 27th.	Indicated.	Difference.
	°	°	°
Clifton	28	29	−1
Fruita	25	25	0
Fruitvale	28	25	+3
Hunter	26	25	+1
Loma	24	25	−1
Orchard Mesa	29	26	+3
Palisade	31	31	0
Pomona	26	24	+2
Redlands	27	28	−1
Grand Junction	31	31	0

NOTE.—Weather maps for the two dates were quite similar, but insolation on the 26th gave higher maxima than occurred on the 25th, and the higher maxima when used in the formula indicated slightly higher minima for the 27th.

[1] See MO. WEATHER REV., Suppl. 16, 1919.